Edes (R. T.)

HYDRONEPHROSIS AND RENAL ATROPHY;

ESPECIALLY AS RESULTING FROM FUNCTIONAL DISTURBANCES OF MICTURITION.

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FROM

THE MEDICAL NEWS,

August 10, 1889.

[Reprinted from THE MEDICAL NEWS, August 10, 1889.]

HYDRONEPHROSIS AND RENAL ATROPHY; ESPECIALLY AS RESULTING FROM FUNCTIONAL DISTURBANCES OF MICTURITION.

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HYDRONEPHROSIS is a dilatation of the pelvis and calyces of the kidney from retention of the secretion. It may vary from the slightest stretching of the pelvis beyond its normal dimensions, with perhaps a slight flattening of the papillæ, up through all the stages of gradual distention of the cavity and atrophy of the renal substance, until the kidney becomes a mere shell of fibrous tissue, to which are attached a few remnants of true renal parenchyma retaining somewhat of their structure and function. This condition may affect both of the kidneys, or one of them, or in some cases only a part of one.

It is so nearly always the result of a demonstrable anatomical obstruction in the normal flow of the urine that, in the few cases in which the exact seat and nature of the obstruction cannot be discovered, it is fair to conclude that the exception does not indicate an independent pathology, but simply that

hindrances may exist which are not obvious to the sound or on the dissecting table. This remark applies quite as fully to congenital as to acquired hydronephrosis.

The object of my paper is to suggest that in some of these exceptional cases the search, if prosecuted during life physiologically and clinically, will reveal causative conditions not evident upon the post-mortem table, but, notwithstanding, really sufficient for the effect produced.

The points at which obstructions may occur are many; and according to their positions will be the amount and character of the changes existing above them; not only the dilatation, which is the subject of the present paper, but the inflammatory and degenerative alterations in addition. These lesions have been carefully studied and described, and I will take but a few moments in a brief recapitulation.

The ureters may be occluded by a calculus at any point from their exit from the pelvis to their entry into the bladder.

Wounds or blows on the back may cause compression of the ureters by means of hemorrhagic or inflammatory effusions.

An obstacle may also exist anywhere in their length in the form of a valve or fold, constituted either by the mucous membrane or by the whole thickness of the tube. Such a valve, although retaining the secretion most of the time, may be pervious under some states of distention or position; and in this way are formed the so-called intermitting hydronephroses. Folds or kinks existing in

the ureters have long been recognized as obstructions, but it is possible in some cases that these may be, in part at least, secondary, inasmuch as when a hydronephrosis occurs from other causes which may be temporary, the ureter is not only dilated but also lengthened, and is obliged to form a fold in order to accommodate itself to the surrounding parts. They are frequently, however, of such form and in such numbers that no such explanation is admissible.

The ureters may be congenitally impervious through the whole or in any part of their course. (*Trans. Path. Soc. London*, xv.; *Bull. Soc. Anat. de Paris*, 1867, xxxi. 11, 305.) They may have no opening into the bladder or even attachment to it. (*Med. Times and Gaz.*, 1876, i. 546.) In some such cases there is an attachment to the rectum but without an opening into it. (Gerster: *N. Y. Med. Journal*, 1878, xxviii. 511.) When arrested or irregular development of this kind occurs in the ureters, it is not uncommon, in fact usual, to find associated with it other deformities, frequently of the intestinal canal, but often of entirely separate regions; as, for instance, the hands and feet, showing a tendency in this direction more than local. There have been instances where a woman has borne several hydronephrotic children in succession.

Whenever the obstruction exists long enough there will be a dilatation of the parts above, not necessarily everywhere equal, since the ureters differ in density and in the amount of outside support they receive at different parts of their course. It is not

unusual to find in the course of a ureter which is elsewhere considerably dilated, points at which it retains its normal calibre. One of these points is likely to be found just where the pelvis of the kidney joins or becomes the ureter.

Compression of the ureters may be caused by bands of adhesions and in a few cases by a branch of the renal artery passing across them.

Among the more common external obstacles are to be found pelvic tumors and in particular cancer of the uterus. Displacement of the uterus, and in particular prolapse, can have this effect by twisting and dragging on the ureters.

The brim of the true pelvis, where the ureter makes a somewhat abrupt turn, and is especially liable to compression in passing from the abdominal cavity down behind the bladder, may cause an obstruction to the flow of urine, as will be shown by the difference of calibre, the tubes being dilated above and normal below. (*Medical Record*, 1887, xxxii. 734.)

As we come lower, omitting the bladder itself, which will be more fully discussed later, we may find the obstacles where the urethra leaves the bladder. This may be absolutely impervious, there being no orifice whatever, its proper position being indicated by a papilla (Billard: *Maladies des Nouveau nés;* Lehmann: *Nederland. Weekblad.*, 1853, No. 12); or there may be an adhesion of the sides of the urethra in this region too strong to be overcome by the pressure of urine, but yet easily broken up by an instrument passed in the usual way, which re-

lieves the distended bladder and removes its cause, or cutting may be necessary. (Lamotte: *Traite des Accouchements;* Smellie's *Midwifery.*) In other cases nearly the whole urethra may be obliterated or wanting (Lehmann, loc. cit.). It may, like the ureters, be obstructed by a valve of mucous membrane. (*Bull. Soc. Anat. de Paris*, 1869, p. 130.)

In the adult the hypertrophied prostate is a not infrequent obstacle, and gives rise to an incipient or moderate bilateral hydronephrosis, as in the specimen just shown by me,[1] and in one by Dr. Prentiss (*Maryland Medical Journal*, April, 1883), and in many others too numerous to quote.

The function of the kidneys may not be seriously disturbed for a long while.

If a cystitis is added, as it is likely to be, we may then have, not a simple dilatation of the passages, but, from the fact that it is an inflammatory urine which is backed up into the kidneys, a pyo- instead of a hydro-nephrosis.

This list is to be extended by the mention of strictures of the urethra, of which there are several specimens in the Army Medical Museum, and of papillomata in the neck of the bladder.

Finally, the prepuce may present an efficient obstacle in the form of a phimosis, although the irritation of an adherent foreskin may lead to hydronephrosis by another chain of causation, as will be seen later on.

Many of the conditions mentioned can, of course,

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[1] To the Medical Society of the District of Columbia.

exist only in the fœtus or the newborn. Where a sufficient amount of depuration of the blood can be carried on by the circulation of the mother without reference to the activity of the fœtal organs, one or both kidneys may, even if entirely obstructed, continue to grow into the enormous tumors of this kind sometimes met with. A certain amount of time is requisite for the development of an extreme degree of hydronephrosis. It is a process of growth and not simply one of distention, and since after separation from the mother an absolutely complete occlusion of both ureters in the child must lead to death by uræmia before the dilatation can reach its extremest limits, we meet with the most striking examples of double hydronephrosis in connection with impervious urinary passages only in the fœtus or the newly born. The abdominal swelling in some of these cases of congenital hydronephrosis may be so great as to constitute a serious hindrance to delivery or, on the other hand, the pressure during delivery may be so great as to force a passage of the urine in spite of the resistance and empty the sac.

In adults an absolutely impermeable obstruction may exist upon one side and a slight or moderate hydronephrosis be formed in consequence, but, when the dilatation is bilateral or when it is extreme on one side, it must have been the result of an obstacle sufficient to increase the pressure under which the urine was secreted during a long time, but not sufficient entirely to stop it at once. The stoppage may finally become an absolute one, but cannot have been so from the beginning.

It is a curious fact that the amount of urine passed against a certain degree of back-pressure instead of being diminished, as we should naturally expect from a knowledge of the physical laws governing this secretion, is increased. The back-pressure, when not too great, seems to act as a stimulant to the secreting structure. If, however, it gets beyond this point, the secretion obeys the ordinary law of physics and takes place more slowly.

After the consideration of these and all similar causes for hydronephrosis, we are likely to meet with cases which are not to be explained thereby. My former instructor, Prof. J. B. S. Jackson, went so far as to say that in a large proportion of cases, so far as he had seen, no cause whatever could be assigned. We may accept, as expressing the general conclusion in the matter, the words of Roberts, who says, "There are cases which must at present be regarded as mechanically inexplicable." I propose now to examine a case or two of my own with reference to the causation and compare them with a few observations I have been able to find in medical literature.

Case I.—A boy, aged five, was seen by me in December, 1882, with my friend Dr. Gilbert, of Dorchester. He looked rather less robust than his younger brother and sister. He had always been in the habit of wetting his bed and clothes. Recently his habits had improved, although he still passed a small amount of urine in his clothes. He did not, however, entirely empty his bladder in this way, as his mother said he could always pass water

whenever they tried him. There was no difficulty in micturition. He passed a full stream. The daily quantity was considerably increased and was of low specific gravity with a small amount of albumin and a slight sediment of small cells, but no casts. Two years later the urine was still lighter and it contained albumin, but no casts. A short time before his death he had several attacks of retention of urine. He had headache for a month or two, and his death was immediately preceded by convulsions.

At the *autopsy* the body was found emaciated. The heart was hypertrophied, especially the left ventricle. The right kidney was represented by the dilated pelvis and a small nodule of secreting structure at one end and a few thin pieces elsewhere; right ureter dilated. The left kidney somewhat atrophied, mottled with yellow, lobulated, capsule adherent, pelvis and ureter slightly dilated, but much less than right. Bladder large, the walls more trabeculated than would be expected in a child of his age. No obstruction anywhere in ureters found. Free passage of water into bladder and free passage of sound in either direction. Urethra free to sound in either direction.

The next case lacks the confirmatory evidence of a post-mortem but presents what is better, the result of treatment directed to the relief of the causative condition.

Case II.—A rather delicate girl, aged three, was seen by me in consultation with Dr. Rice, of Grafton, Mass., in January, 1886. She had had a convulsion in the previous July and some feverish attacks since. She had passed urine in large quantity and with some effort for some months, and these were

all the obvious symptoms. The urine was of low specific gravity and contained a large trace of albumin with pus, blood, epithelium from the neck of the bladder, renal epithelium, and some casts. A previous examination had discovered some epithelium from the pelvis of the kidneys. She was placed on the benzoate of lithium, with which her general condition improved, and she went through the night without passing water, but the albumin, pus, and casts remained, and were noted on several examinations up to March 7th. On the 8th the bladder and urethra were examined under ether. She passed a full stream of urine and a large bougie entered the bladder without difficulty. A probe detected a little roughness (trabeculation?) at times, but nothing more. On the 26th of March her mother wrote to me that she had seemed much better, appetite very much improved, and since the examination *decided decrease in the effort to pass water*.

The next examination of urine, of which I have a record, shows there was a deposit of pus and some albumin present, but no casts were found after a somewhat prolonged search and only a few large cells.

The urine of June the 14th was opalescent and deposited only a flocculent stratum of pus. One hyaline cast of medium size was found after searching a number of drops. On the 15th a large taper-pointed catheter was introduced into the urethra for puposes of dilatation, and the urine drawn contained neither pus nor casts, and only a small amount of albumin. On the 23d there were a few scattered leucocytes and no casts. Some time in the winter of 1887–8 the urine contained a trace of albumin, but in July, 1888, the attending physician writes

that "It is free from albumsn and the patient is the picture of health."

If we take into consideration cases where hydronephrosis coexists with thickened bladder and a severe chronic cystitis, and where the dilatation is fairly referable to the increased frequency of micturition and the spasmodic contraction of the bladder, we can find a considerable number.

Case III.—In a case under my own observation (seen with my friend, the late Dr. Arnold, of Roxbury, in its last stages), a boy had attacks of dysuria from irritability of the neck of the bladder, and probably cystitis, from the age of six to nine. For some time before his death the urine was pale, scanty, purulent, and ammoniacal. He died with uræmic symptoms. The bladder was thickened and the ureters dilated. The right kidney was represented by a nodule the size of a pea on the outside of the membranous bag. There remained of the left kidney one round mass at the lower end three-quarters of an inch in diameter, and two or three other smaller ones.

I think we have in the first two of these cases a complete and a fortunately incomplete instance of the class recognized by all writers on this subject as "mechanically inexplicable"; inexplicable—that is, if we regard only the conditions found after death or by surgical examination, since we find a hydronephrosis with indications of increased work on the part of the bladder, but the passages everywhere freely permeable to instruments in either direction;

not altogether inexplicable, if we regard the action of the bladder and the function of micturition.

The amount of back-pressure in the kidneys required to produce a complete compression of the secretion is estimated at about one and six-tenths inches of mercury, while less than half an inch will greatly impair it.[1] Since, then, in most cases of hydronephrosis the secretion is not checked, but the contrary, we may safely say that a very small amount of back-pressure in the bladder, if constant or frequently repeated, is sufficient, after a time, to produce slighter grades of hydronephrosis with consequent destruction of kidney substance.

Normally, of course, there is little pressure in the bladder most of the time. Once emptied, it fills again with urine coming down the ureters, partly perhaps by hydraulic pressure, but largely by the peristaltic movements analogous to those by which the intestinal contents are propelled.

To this there is little or no resistance on the part of the bladder until a certain degree of distention is reached, varying, not only according to its total capacity, but according to its irritability, when it is emptied by a contraction of one set of muscles and relaxation of their opponents.

It is stated that the detrusor urinæ is able to overcome the resistance of the sphincter vesicæ, but it comes within the personal experience of everyone who has been obliged by circumstances to delay the

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[1] Wundt: Physiologie des Menschen, p. 434. Quoted by James: Physiological and Clinical Studies, Edinburgh, 1888.

evacuation of the bladder after it has become overfull, that something more than overcoming a passive resistance is necessary in the act of micturition. There must be a simultaneous and harmonious relaxation of the sphincter as well as stimulation of the detrusor. In this respect micturition may be said to resemble vomiting, where efforts of the abdominal muscles are unable to evacuate the stomach until the cardiac orifice relaxes.

The function of the urinary bladder in receiving and discharging the urine at more or less regular intervals is not a purely passive one. It should be a pump as well as a reservoir. Its proper action in this way depends on a proper relationship between the forces that propel and those that restrain its contents, and when these forces are so disordered that it fails to perform its function, or performs it insufficiently, then more work is thrown upon the other propelling forces. These are: first, the pressure under which the urine is secreted, which, as we have seen, is but slight, since half an inch of mercury pressure will materially impair it; and, secondly, the peristaltic movements of the ureters.

During the normal act of micturition no urine can, of course, enter the bladder from the ureters, but since the emptying of the bladder occupies so short a time no harm is done. The amount of urine which accumulates in the ureters during this interval is too small to distend them beyond the proper limits. If, however, the contractions be very frequent and long continued there will be enough accumulation of urine in the ureters to cause their

dilatation, and, subsequently, that of the kidneys. This dilatation, by weakening the walls of the ureters, will naturally tend to increase rather than decrease. Such frequent contractions result, as we well know, from various sources of irritation in the urinary tract, but especially from inflammation of the bladder itself, or of the urethra.

Suppose, now, on the other hand, the detrusor to be weakened relatively to the sphincter, or, what amounts to the same thing, the resistance of the sphincter to be increased, we may have a considerable accumulation of urine taking place against the constant elastic pressure of the bladder which is not, however, sufficient to empty it, and allow the flow from the ureters to go on again without resistance. We then have the condition of incontinence from retention—*i. e.*, a bladder full to overflowing, so often seen in the old, usually in connection with enlarged prostate, but not common in the young. The kidneys and ureters are thus working against a pressure, never very great perhaps, but always above the normal, exactly the condition to produce a gradual distention. If the voluntary muscles of the abdomen are called upon to assist the contractions of the bladder, the matter is made worse rather than better, for they cannot exercise so equal a pressure in every direction as the constrictors of the bladder itself, and the entrance to the ureters is not guarded, under the circumstances, as in the normal condition' by the contraction of the fibres immediately surrounding them. Urine may thus be forced upward as well as downward. The absence of the valvular

condition of the entrance of the ureters into the bladder is expressly noted in two of the subsequent cases of paralysis of the bladder.

It will, of course, be understood that the amount of pressure required to produce dilatation in the course of weeks or months is an entirely different amount from that which would be necessary suddenly to dilate the organs to the size they may attain even in the more moderate cases of hydronephrosis. In fact, it would probably be impossible to arrive at this state of things by any rapid process.

Hydronephrosis, then, may take its rise in two distinct forms of faulty innervation, paralysis and spasm. This origin is not fully recognized in medical literature, but a few cases may be quoted in support of my view.

Augè (*Thèse de Montpellier*, 1878) reports a case of hydronephrosis from paralysis of the bladder, of which, however, the clinical details are too scanty to make it of much value for our purpose. The bladder was greatly dilated, it was thin, and the mucous membrane injected and punctated. The ureters were much dilated and the inferior orifices opened. The pelves of the kidneys were dilated and the tissues progressing toward atrophy.

The following somewhat resembles the first of mine. Bernard (*Journ. Sc. Méd.*, Lille, 1881, p. 546) describes the case of a child, aged thirteen, who had incontinence of urine, wetting the bed, and passing water into his clothes during the day; he could pass water whenever he pleased, with some difficulty, the jet being short, and he being obliged

to contract energetically the abdominal muscles. When sounded, the bladder was found to contain a considerable quantity of urine, but there was no obstacle to catheterism, and no calculus. The musculi recti abdominis were hypertrophied. There was a large quantity (three litres) of urine passed, which deposited muco-pus. After death the bladder was found to contain urine, pus, and blood, and was as large as the fist. Ureters dilated. Of the left kidney the structure was entirely gone; in the right the changes were less advanced, but there were abscesses. The ureters were without the usual valvular opening into the bladder, being without any intra-parietal portion. There was thickening of the walls of the bladder, and slight cystitis, but the urethra was normal.

James (*op. cit.*, p. 42) reports the following: A child had, at three, phimosis as the result of an injury. After this had been "pricked by a doctor," the swelling got better, and he seemed nothing the worse. He had then no incontinence. The incontinence began at the age of four. After this a feverish attack which weakened him, and, on admission to the infirmary at the age of eight, he looked thin and weakly. The prepuce was contracted and almost completely adherent to the glans. No pain, but great incontinence. There was increased frequency of micturition, often three or four times in an hour. Only a few drops of urine were passed at a time, and the bladder was never distended. The quantity of urine was probably increased, and it was pale, with a small amount of pus and renal cells.

Circumcision gave temporary relief, but he finally died comatose.

The bladder was somewhat contracted, and its walls thickened.

There was no cystitis, but great roughness, owing to the hypertrophied muscular fasciculi and diverticula. The cavity of the bladder, when distended, was smaller than natural, and the walls about a quarter of an inch thick. There was no stricture in the urethra, and the openings of the ureters through the bladder-wall were normally patent. Both ureters were greatly dilated in their entire length: both kidneys were hydronephrotic.

The author remarks that this is one of three similar cases, in the other two of which the cause of the urinary irritation was the condition of the prepuce. He also mentioned other cases where incontinence, associated with an abnormally light urine, was relieved by circumcision.

The following references belong to cases which may have had something of this character, but in which the clinical details are not sufficient to enable us to classify them with certainty.

A case read by Dr. Acker to the Medical Society of the District of Columbia, on February 13, 1889: A child of five had phimosis, but was said always to pass a good stream. The urine was said to be normal, but latterly profuse. Death from tuberculosis. The bladder was thickened, and the ureters and pelves of the kidney slightly dilated.

Webster (*U. S. Med. and Surg. Journal*, June, 1835).

Ramsbotham (*Proc. Path. Soc. London*, 1848–49, p. 75).

Little (*Path. Trans.*, 1861–62).

Broadbent (*Path. Trans.*, xvi. p. 165). The reporter of this last case thinks there may have been a valve in the urethra because one was found in the ureter.

There is a point in the first one of my cases to which I should like to call attention, although not intimately connected with the subject of the paper —that is, the occurrence of hypertrophy of the heart in connection with a purely local disease of the kidneys. This has been noted in other cases, some of which I have come across in consulting the literature of the subject without this special object in view. It has occurred in cases of traumatic origin.

These facts are not in harmony with the theories largely held in regard to the connection of cardiac and renal disease, nor indeed with that which I have myself advocated, to the effect that this connection consists in a common dependence on a primary condition of the whole arterial system, at first functional, and afterward structural. They seem to show that, sometimes at least, the kidney lesion may be directly causative of the cardiac change, and without any intervention of arterial degeneration.

The following report cases of the kind:

Footner (*British Med. Journal*, 1878, xi. 57).

Weill (*Mém. et Comptes Rendus de Soc. de Méd. de Lyon*, xxiii. Pt. 2).

Soller (*Lyon Méd.*, vol. xxxv. p. 233).

Is it not possible that some cases of interstitial nephritis in the young, even when they are accompanied by hypertrophy of the heart and by the other symptoms usually found in older persons, may originate in some local trouble, and not be so closely connected with a constitutional affection as those with which we are more familiar in persons in middle life? Certainly the causes to which we attribute, so far as we can, chronic interstitial nephritis are less operative in the young.

It seems to me not unreasonable to suppose that even that quite slight obstruction to the flow of urine may, by the mechanism described above, and without producing more symptoms than can easily be overlooked, set up an amount of renal irritation that will in time run into chronic interstitial nephritis; and that the back-pressure may be so slight as to fail to dilate the ureters and exert itself solely on the renal substance. This, I admit, is pushing my doctrine to its extreme limits and beyond the bounds of demonstration, but I offer the suggestion for what it is worth.